Space Weather Technical Forecast

Issued on Wednesday, 05 April 2023 at 00:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Active electron fluence likely. Slight chance of Minor Geomagnetic Storms at first, soon declining. Slight chance of M-class flares throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with no significant flare activity. There are currently four active regions on the visible disc. AR3270 is the most prominent region on the visible disc, having recently shown growth in its intermediate spots and briefly developing a delta spot in this area. The three remaining regions are both small and simple. No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1, appears to be under the influence of a high speed stream, likely now from either of coronal holes 89 or 90. Wind speed has been slightly elevated or elevated, varying between 480-550 km/s. Density has been steady at either average or just slightly above average levels. Magnetic field strength, Bt, has been weak below 7 nT. The north-south component, Bz, has also varied weakly between +/- 6 nT. Phi angle was predominantly negative, towards the Sun. Geomagnetic activity was Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has been at background levels. The high energy electron flux (greater than 2MeV), as measured at GOES16, reached 2420 pfu at the diurnal peak, at 04/1715UTC. Electron fluence was on a declining trend below Active but with a slight recent recovery. 8.15e7 integrated pfu was recorded at 05/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be mainly Low, with a slight chance of Moderate activity.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are currently expected. Solar wind speeds are at slightly elevated or elevated levels, due to a high speed stream from either of coronal holes 89 or 90. A slow decline in wind speeds through Days 1 and 2 (05-06 Apr) to near background levels seems most likely.

Geomagnetic activity is forecast to be Quiet to Active on Day 1, with a slight chance of isolated G1/Minor Storm intervals in any more prolonged periods of negative Bz. Activity is expected to gradually decline however, to become mostly Quiet by Day 3 (07 Apr).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES-16 is at background levels and is likely to remain so, unless a more significant flare occurs. Electron flux values are expected to vary between moderate and high levels. Electron fluence is likely to be near or just below the Active (1e8 integrated pfu)

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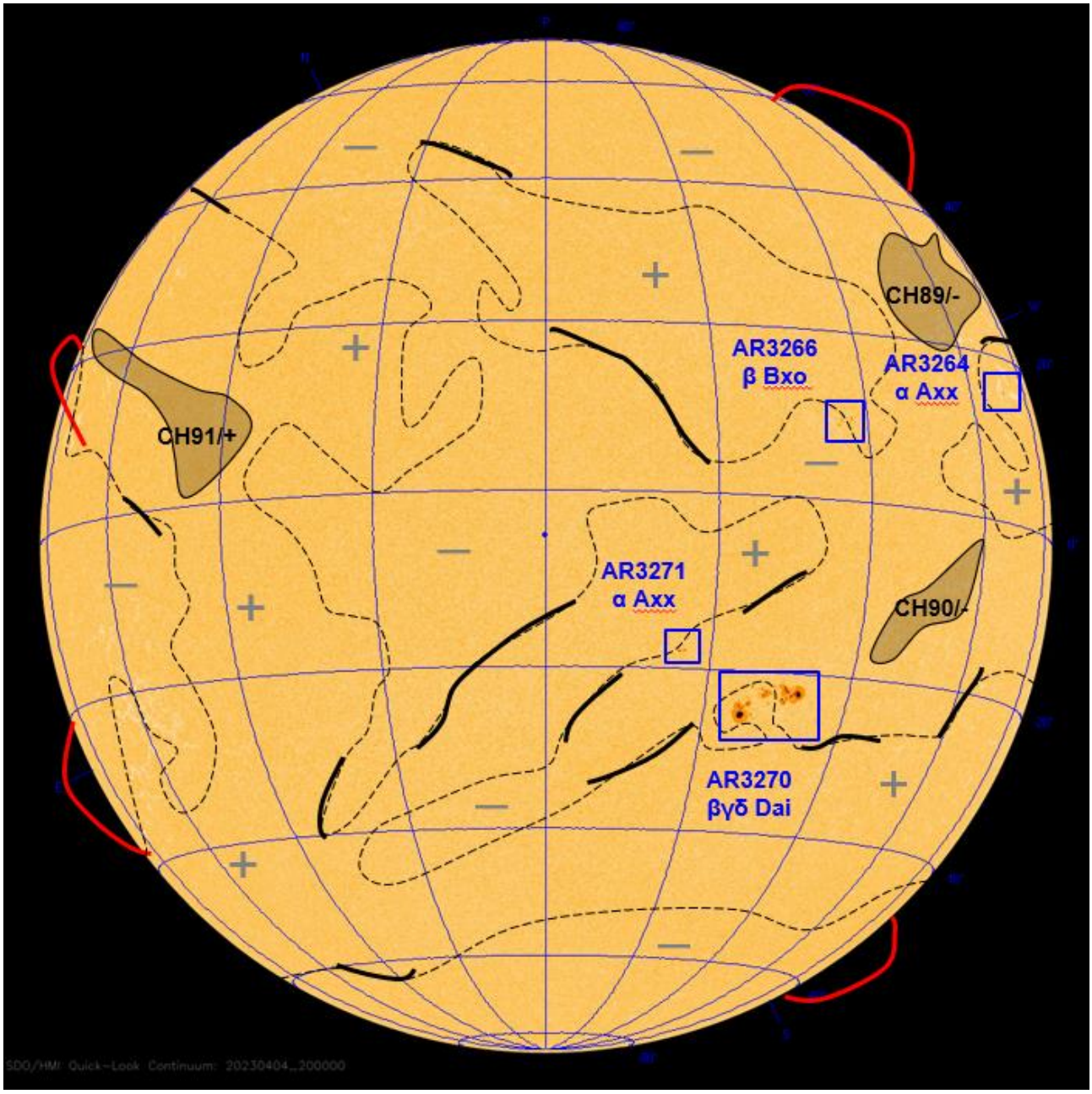
threshold, perhaps increasing slightly later in the period.

Figure 1. Solar Analysis Valid 04/2000 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No Earth directed CMEs are currently expected.

Solar wind speeds are at slightly elevated or elevated levels, due to a high speed stream, likely from either of coronal holes 89 or 90, with any effect from coronal hole 88 now expected to have waned. These are both negative polarity holes, and as such may have a stronger geomagnetic response near the March equinox. Persistence is not especially helpful as the coronal holes appear changed from the last rotation, but a slow decline in wind speeds through Days 1 and 2 (05-06 Apr) to near background levels seems most likely.

Geomagnetic activity is forecast to be Quiet to Active on Day 1, with a slight chance of isolated G1/Minor Storm intervals in any more prolonged periods of negative Bz. Activity is expected to gradually decline however, to become mostly Quiet by Day 3 (07 Apr).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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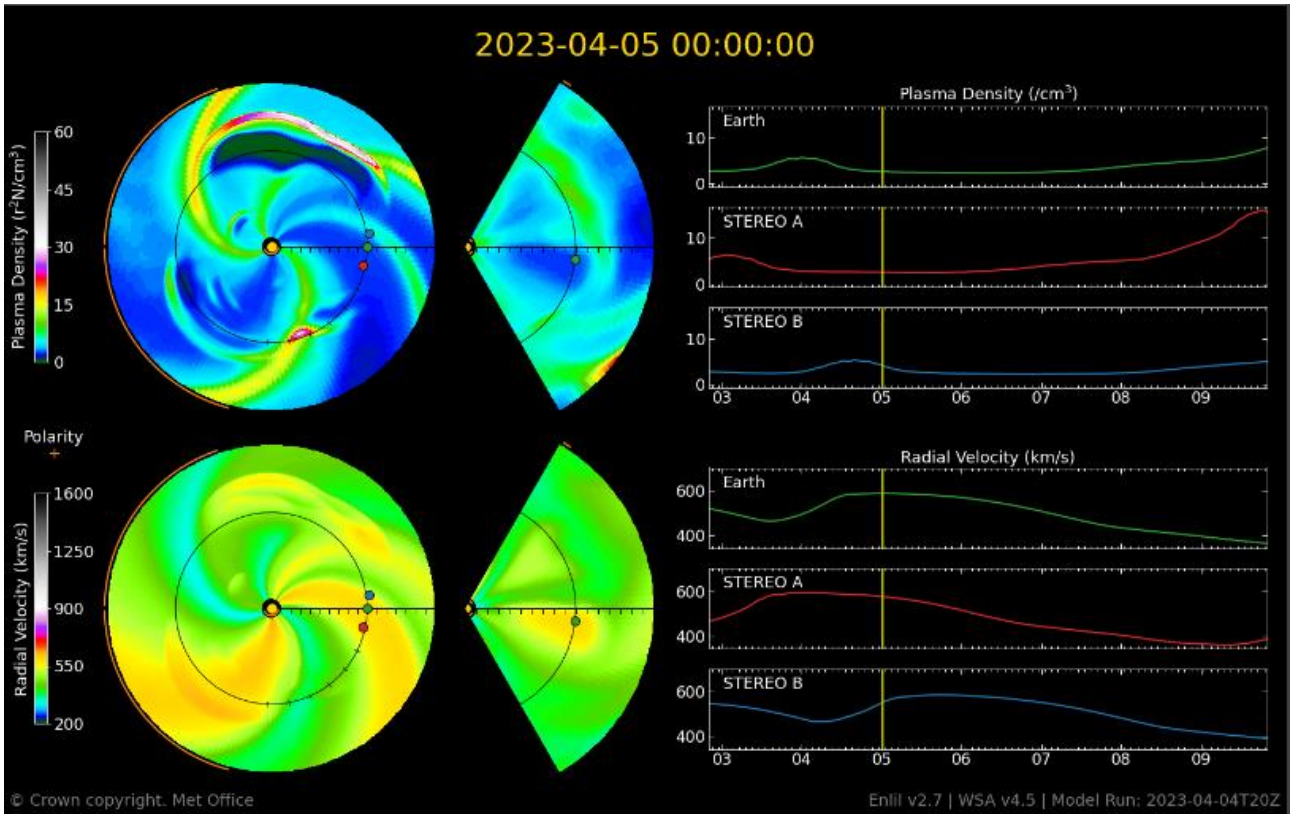
Figure 2: MOSWOC Enlil showing a slow decline from the current high speed stream, which looks like good guidance.



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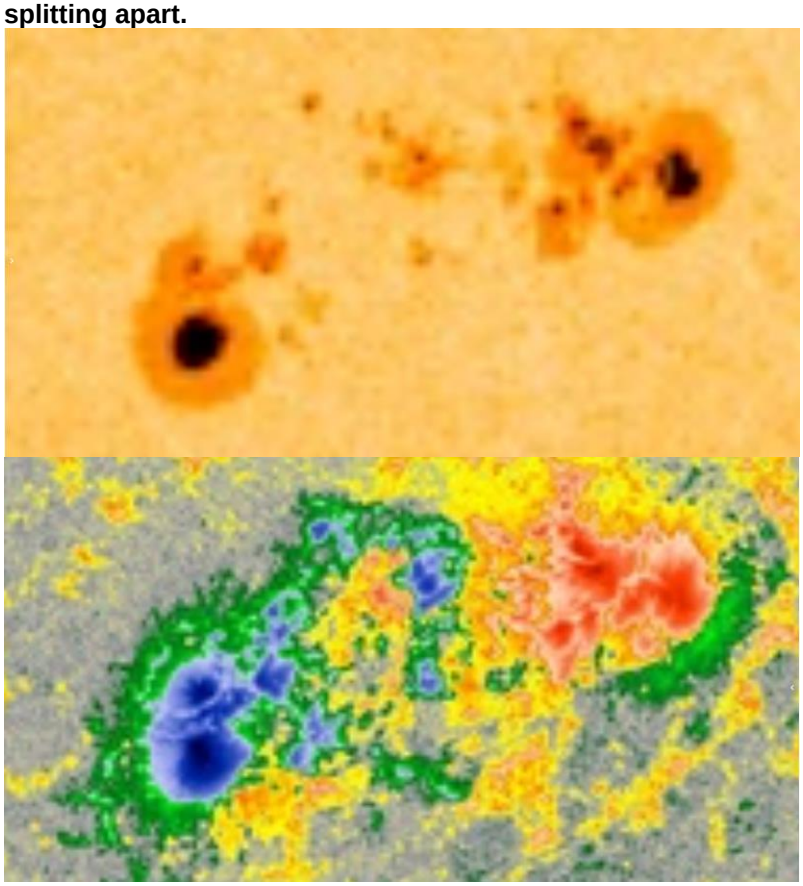
Radio Blackouts - X-Ray Flares:
There are now four sunspot regions on the visible disc, all of these in the western hemisphere. AR3270 (Dai/Beta-Gamma-Delta) has shown recent development of its intermediate spots, with a delta spot briefly forming within this region although this now appears to have split apart. As such it is the main flare risk at present, although the recent lack of flare activity means that probabilities remain fairly low. Three further sunspot regions are small and simple at present, with no significant regions expected to rotate onto the eastern horizon in the next four days.

Solar activity is forecast to remain Low, with a slight chance of Moderate activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: AR3270 which was showing a delta region in one of the intermediate spots, but this is now splitting apart.



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES-16, is forecast to remain at background levels, pending any significant sunspot development. There is just a slight chance of protons reaching the S1 level, most likely from AR3270 which is in a good position to connect with Earth should a larger flare occur in the coming days.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	3	3	3	3
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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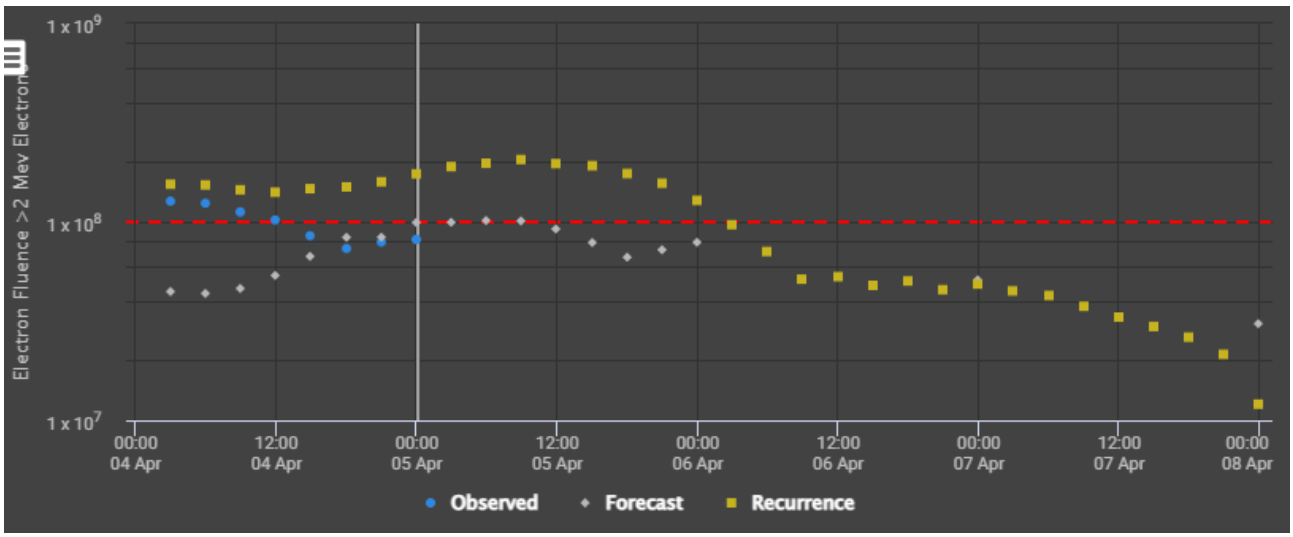
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is forecast to continue to oscillate between moderate and high (1000 pfu) levels through the forecast period, due to the ongoing high speed stream effects. The British Antarctic Survey radiation belt model (BAS-RBM) is forecasting an increased density of electrons held below GEO, so there is a small chance that a forecast decline in solar wind speeds (and consequently solar wind pressure) could lead to an expansion of electrons towards GEO later in the period.

Electron fluence values have declined just below Active (1e8 integrated pfu), but with a recent slight increase. The MOSWOC REFM model has until recently been under-forecasting the level of the electron fluence, with a declining trend forecast in the coming days. Overall, it seems possible that fluence may just reach Active levels again in the coming hours, with levels probably staying near or just below Active, although confidence is low. The slight increase in probabilities later in the period reflects the assessment that the radiation belts may relax back towards GEO orbits, bringing increased electron counts.

GEO Electron Environment	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	70	50	50	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM showing a gradual decline in fluence in the coming days. Fluence may remain a little closer to the Active threshold.



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